

100-kHz Frequency Divider, Distribution Amplifier

G. Lutes

Communications Systems Research Section

A 1-MHz to 100-kHz frequency divider, distribution amplifier module having low phase noise and low phase drift with temperature and high isolation between outputs has been developed for use in the hydrogen maser frequency standard, where it divides 1 MHz from the previous frequency divider down to 100 kHz and provides four transistor-transistor logic (TTL) outputs.

One-hundred-kilohertz divider, distribution amplifier modules have been developed for use in the hydrogen maser frequency standard. These modules develop a 100-kHz TTL-level signal by dividing the 1-MHz emitter-coupled logic (ECL) level signal from the previous frequency divider by 10 and then translating it to TTL-level signals which are distributed to the four outputs through line driver isolation amplifiers.

If the digital signal at 100 kHz were to be converted to a sine wave, another module would be required, which would increase the cost of the system. This conversion would also degrade the signal, and the degradation could become much greater if the sine waves were converted back to TTL levels by the user. Since this frequency is most often used as a clock, we thought it best to condition the signal for this use.

These frequency dividers are optimized for low phase noise and low phase drift with temperature. Low phase

noise is achieved by the use of ECL circuitry in the digital frequency divider and by using amplifiers having a large amount of negative feedback.

As seen in the block diagram (Fig. 1), the input circuit is an ECL digital frequency divider, which divides the input from 1 MHz to 100 kHz. This divider circuit is nearly identical to the 100- to 10-MHz divider circuit used in the 100-MHz frequency divider module. The only difference is that no comparator is used at the input to the divider since it receives a 1-MHz ECL-level signal from the previous module.

The 100-kHz, ECL-level signal goes through a translator having four TTL-level outputs which drive the four inverting field effect transistor (FET) input line driver isolation amplifiers. The signal from these amplifiers has the inverse polarity due to the amplifier. This inversion is corrected by a level shifting circuit at the output. Table 1 shows the test results of a typical 100-kHz divider, distribution amplifier module.

**Table 1. Test results of typical 100-kHz divider,
distribution amplifier module**

Input impedance (50 Ω nominal)	1.1:1 VSWR
Output impedance (50 Ω nominal)	1.1:1 VSWR
Output signal level	−0.6 to +2.7 V square wave into 50 Ω
Phase noise	−150 dB below carrier (100 kHz) in a 1-Hz bandwidth 10 Hz from carrier
Power supply requirements	+5 V, 52 mA −5 V, 290 mA +15 V, 180 mA −15 V, 195 mA

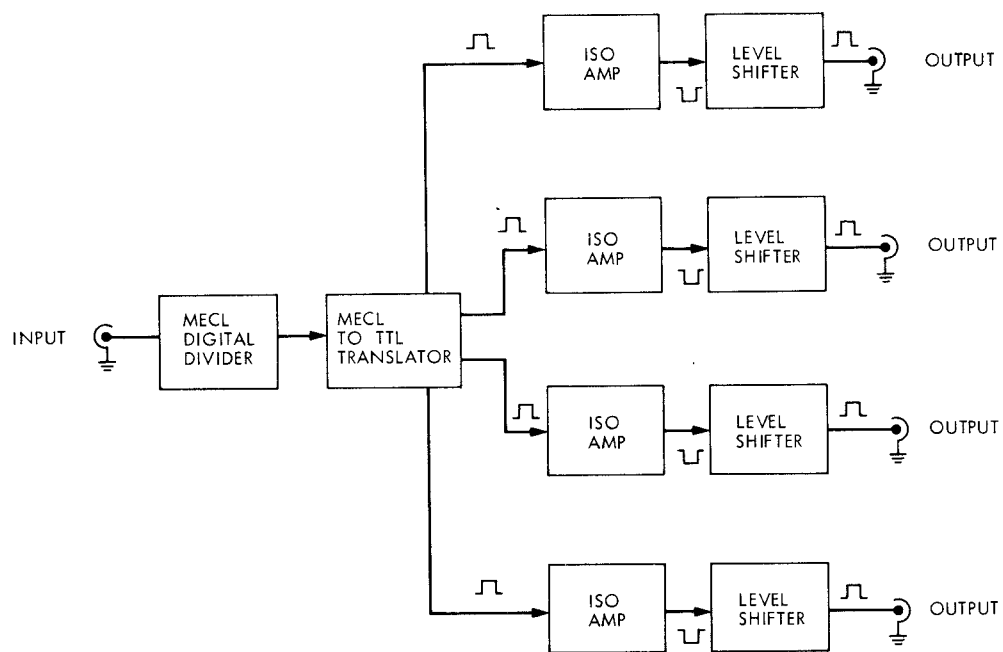


Fig. 1. 100-kHz frequency divider, distribution amplifier block diagram